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PATENT

Attorney Reference Number 3382-65017-01
Application Number 10/644,258

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Claims

1.-35. (canceled)

36. (currently amended) A method for decoding a bitstream for a sequence of video frames, the method comprising:

receiving and processing first information for the sequence, wherein the first information indicates whether multiple spatial resolution coding is enabled for the sequence;

[[if]] determining the first information indicates that multiple spatial resolution coding is enabled for the sequence, and then for each of plural frames in the sequence,

receiving and processing second information at frame level in the bitstream, the second information indicating one or more spatial resolution scaling factors for the frame; and

outputting a result of the processing;

wherein the plural frames comprise at least one I-frame and at least one P-frame, wherein each of the at least one P-frame has a reference I-frame among the at least one I-frame, and wherein for each of the at least one P-frame the one or more spatial resolution scaling factors are constrained to be identical to the one or more spatial resolution scaling factors for the reference I-frame for that P-frame.

37.-38. (canceled)

39. (previously presented) The method of claim 36 wherein the one or more spatial resolution scaling factors are determined adaptively based at least in part on bitrate criteria.

40. (previously presented) The method of claim 36 wherein the one or more spatial resolution scaling factors are determined adaptively based at least in part on high-frequency content criteria.

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41. (previously presented) The method of claim 36 wherein the one or more spatial resolution scaling factors are determined adaptively based at least in part on quantization step size criteria.

42.-64. (canceled)

65. (previously presented) The method of claim 36 wherein the second information is a fixed-length code.

66. (previously presented) The method of claim 65 wherein the fixed-length code is a 2-bit code that represents 4 possible states of the one or more spatial resolution scaling factors.

67. (previously presented) The method of claim 36 wherein the second information is a variable-length code.

68. (previously presented) The method of claim 36 wherein the first information is signaled in a sequence header.

69. (previously presented) The method of claim 68 wherein the first information is a 1-bit code in the sequence header.

70. (previously presented) The method of claim 36 further comprising:
receiving and processing third information in the bitstream, the third information indicating a selected re-sampling filter.

71. (previously presented) The method of claim 36 wherein the one or more spatial resolution scaling factors comprise a vertical spatial resolution scaling factor and a horizontal spatial resolution scaling factor.

72. (previously presented) The method of claim 71 wherein the vertical spatial resolution scaling factor differs from the horizontal spatial resolution scaling factor.

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73. (previously presented) The method of claim 71 wherein the vertical spatial resolution scaling factor is selected from a set of vertical spatial resolutions comprising full resolution and half resolution.

74. (previously presented) The method of claim 71 wherein the horizontal spatial resolution scaling factor is selected from a set of horizontal spatial resolutions comprising full resolution and half resolution.

75. (currently amended) The method of claim 36 further comprising:
~~if the first information indicates that multiple spatial resolution coding is enabled for the sequence, decoding the sequence of video frames~~ decoding the plural frames with multiple spatial resolution decoding according to the spatial resolution scaling factors indicated by the second information;
~~otherwise, decoding the sequence of video frames without multiple spatial resolution decoding; and~~
displaying the ~~sequence of video~~ the plural frames.

76. (previously presented) The method of claim 75 wherein the decoding with multiple spatial resolution decoding comprises:
decoding a current frame of the plural frames encoded at a reduced spatial resolution; and
after decoding the current frame, up-sampling the current frame, wherein the up-sampling yields a full-resolution decoded frame.

77. (previously presented) The method of claim 76 wherein the up-sampling comprises applying a 10-tap filter to the decoded current frame.

78. (previously presented) The method of claim 76 wherein the displayed current frame at the reduced spatial resolution comprises reduced blocking artifacts.

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79. (currently amended) A method of encoding a bitstream for a sequence of video frames, the bitstream having plural levels, the method comprising:
outputting first information for the sequence, the first information indicating whether multiple spatial resolution coding is enabled for the sequence; and
~~if the first information indicates~~ determining that multiple spatial resolution coding is enabled for the sequence, and then for each of plural frames in the sequence:

outputting second information at frame level in the bitstream, the second information indicating one or more spatial resolution scaling factors for the frame;
wherein the plural frames comprise at least one I-frame and at least one P-frame, wherein each of the at least one P-frame has a reference I-frame among the at least one I-frame, and wherein for each of the at least one P-frame the one or more spatial resolution scaling factors are constrained to be identical to the one or more spatial resolution scaling factors for the reference I-frame for that P-frame.

80.-82 (canceled)

83. (previously presented) The method of claim 79 wherein the second information is a fixed-length code.

84. (previously presented) The method of claim 83 wherein the fixed-length code is a 2-bit code that represents 4 possible states of the one or more spatial resolution scaling factors.

85. (previously presented) The method of claim 79 wherein the second information is a variable-length code.

86. (previously presented) The method of claim 79 wherein the first information is signaled in a sequence header.

87. (previously presented) The method of claim 86 wherein the first information is a 1-bit code in the sequence header.

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88. (previously presented) The method of claim 79 further comprising:
outputting third information in the bitstream, the third information indicating a selected
re-sampling filter.

89. (previously presented) The method of claim 79 wherein the one or more spatial
resolution scaling factors comprise a vertical spatial resolution scaling factor and a horizontal
spatial resolution scaling factor.

90. (previously presented) The method of claim 89 wherein the vertical spatial
resolution scaling factor differs from the horizontal spatial resolution scaling factor.

91. (previously presented) The method of claim 89 wherein the vertical spatial
resolution scaling factor is selected from a set of vertical spatial resolutions comprising full
resolution and half resolution.

92. (previously presented) The method of claim 89 wherein the horizontal spatial
resolution scaling factor is selected from a set of horizontal spatial resolutions comprising full
resolution and half resolution.

93. (previously presented) The method of claim 79 wherein the one or more spatial
resolution scaling factors are determined adaptively based at least in part on bitrate criteria.

94. (previously presented) The method of claim 79 wherein the one or more spatial
resolution scaling factors are determined adaptively based at least in part on high-frequency
content criteria.

95. (previously presented) The method of claim 79 wherein the one or more spatial
resolution scaling factors are determined adaptively based at least in part on quantization step
size criteria.

96. (currently amended) The method of claim 79 further comprising:

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~~if multiple spatial resolution coding is enabled for the sequence, encoding the sequence of video frames encoding the plural frames~~ with multiple spatial resolution coding according to the spatial resolution scaling factors indicated by the second information;
~~otherwise, encoding the sequence of video frames without multiple spatial resolution coding.~~

97. (previously presented) The method of claim 96 further comprising:
down-sampling a current frame of the plural frames, wherein the down-sampling yields a reduced-resolution frame.

98. (previously presented) The method of claim 97 wherein the down-sampling comprises applying a 6-tap filter to the current frame.

99. (previously presented) The method of claim 97 wherein the down-sampling comprises down-sampling in a horizontal direction prior to down-sampling in a vertical direction.

100. (previously presented) The method of claim 79 wherein a current frame of the plural frames includes plural lines, and wherein the multiple spatial resolution coding for the current frame includes adjusting number of samples in each of the plural lines so the number is a macroblock multiple.

101. (currently amended) A system comprising:
means for receiving and processing first information in a bitstream for a sequence of video frames, wherein the first information indicates whether multiple spatial resolution coding is enabled for the sequence;
means for receiving and processing second information at frame level in the bitstream for each of plural frames in the sequence if the first information indicates that multiple spatial resolution coding is enabled for the sequence, the second information indicating one or more spatial resolution scaling factors, wherein the plural frames comprise at least one I-frame and at least one P-frame, wherein each of the at least one P-frame has a reference I-frame among the at

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least one I-frame, and wherein for each of the at least one P-frame the one or more spatial resolution scaling factors are constrained to be identical to the one or more spatial resolution scaling factors for the reference I-frame for that P-frame; and
means for outputting a result of the processing.

102. (currently amended) One or more computer-readable media having stored thereon instructions operable to cause one or more computers to perform a method for decoding a bitstream for a sequence of video frames, the method comprising:

receiving and processing first information for the sequence, wherein the first information indicates whether multiple spatial resolution coding is enabled for the sequence;

if the first information indicates that multiple spatial resolution coding is enabled for the sequence, then for each of plural frames in the sequence:

receiving and processing second information at frame level in the bitstream, the second information indicating one or more spatial resolution scaling factors for the frame;
and

outputting a result of the processing;

wherein the plural frames comprise at least one I-frame and at least one P-frame, wherein each of the at least one P-frame has a reference I-frame among the at least one I-frame, and wherein for each of the at least one P-frame the one or more spatial resolution scaling factors are constrained to be identical to the one or more spatial resolution scaling factors for the reference I-frame for that P-frame.

103. (currently amended) A system comprising:

means for outputting first information in a bitstream for a sequence of video frames, the first information indicating whether multiple spatial resolution coding is enabled for the sequence; and

means for outputting for each of plural frames in the sequence second information at frame level in the bitstream if the first information indicates that multiple spatial resolution coding is enabled for the sequence, the second information indicating one or more spatial resolution scaling factors for the frame, wherein the plural frames comprise at least one I-frame and at least one P-frame, wherein each of the at least one P-frame has a reference I-frame among

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the at least one I-frame, and wherein for each of the at least one P-frame the one or more spatial resolution scaling factors are constrained to be identical to the one or more spatial resolution scaling factors for the reference I-frame for that P-frame.

104. (currently amended) One or more computer-readable media having stored thereon instructions operable to cause one or more computers to perform a method of encoding a bitstream for a sequence of video frames, the bitstream having plural levels, the method comprising:

outputting first information for the sequence, the first information indicating whether multiple spatial resolution coding is enabled for the sequence; and

if the first information indicates that multiple spatial resolution coding is enabled for the sequence, for each of plural frames in the sequence:

outputting second information at frame level in the bitstream, the second information indicating one or more spatial resolution scaling factors for the frame;

wherein the plural frames comprise at least one I-frame and at least one P-frame, wherein each of the at least one P-frame has a reference I-frame among the at least one I-frame, and wherein for each of the at least one P-frame the one or more spatial resolution scaling factors are constrained to be identical to the one or more spatial resolution scaling factors for the reference I-frame for that P-frame.